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MEMORANDUM

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THE SACLANTCEN SHALLOW-WATER TRANSMISSION-LOSS DATA-FILING SYSTEM

by

OLE F. HASTRUP, TUNCAY AKAL, ARTURO PARISOTTO



1 OCTOBER 1980 C

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## THE SACLANTCEN SHALLOW-WATER TRANSMISSION-LOSS DATA-FILING SYSTEM,

by

(10)

Ole F. Hastrup, Tuncay Akal, Arturo Parisotto

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1 Oct 1980

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This memorandum has been prepared within the SACLANTCEN Underwater Research Division as part of Project 05.

O.F. Hastrup  
Acting Division Chief  
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## THE SACLANTCEN SHALLOW-WATER TRANSMISSION-LOSS DATA-FILING SYSTEM

by

Ole F. Hastrup, Tuncay Akal, Arturo Parisotto

ABSTRACT

A computerized data-filing system has been developed to store measured transmission losses in a matrix as functions of range and frequency, together with the information giving the basic characteristics of the environment. The main advantages of this system are its easy access and the possibilities for extracting the information in different formats, depending on the requirements.

INTRODUCTION

Since 1968 SACLANTCEN has been conducting a large number of broad-band acoustic propagation measurements in several shallow-water areas, covering zones from the Barents Sea to the Strait of Sicily <1, 2, 3, 4, 5>. During these experiments transmission losses were measured using explosive sources and were recorded as energy transmission losses averaged in 1/3 octave bands, expressed in decibels with reference to one metre. This large amount of data, together with that from some of the NATO nations that have been conducting experiments jointly with SACLANTCEN, has been collated in a standard filing format.

To describe this SACLANTCEN shallow-water transmission loss data filing system, the principle of the system is presented together with input and output data formats and some examples of the graphic display possibilities are shown.

1 DATA-ORGANIZATION

The measured transmission loss data <1, 2> are organized under the following identifiers: CRUISE, RUN, SOURCE DEPTH, RECEIVER (Hydrophone) DEPTH, as shown in Fig. 1.

The filing system basically consists of two parts. Part one, "DATA-LOG" which gives the general information concerning the RUN. Part two "DATA-FILE" gives the actual transmission losses as functions of range and frequency for each source and receiver combination.

### 1.1 Data-Log

The data-log contains all the information concerning the acoustic run such as the receiving ship's position, time, run geometry, water depth, and some environmental description.

The input formats for the data-log identifiers are given in Fig. 2. Figure 3 shows an example of data-log inputs, which creates a corresponding data-log page as seen in Fig. 4.

The four coefficients A, B, C, D, when shown, are obtained from the measured transmission-loss data and serve as a simple, fast method of calculating transmission losses as functions of range and frequency from the semi-empirical formula:

$$TL = 15 \log R + (A+B \log f + C (\log f)^2) R + D \quad (\text{dB}),$$

with R being the range in km and f the frequency in Hz <6>.

When the losses are measured at several depths for a given fixed source depth a depth-averaged transmission loss is also provided, identified as HYD AVR. <1>.

### 1.2 Data File

Apart from the CRUISE, RUN, HYDROPHONE and SOURCE identifiers, the data-file contains the number of ranges, a list of the ranges, and the matrix specifying the transmission loss for each range/frequency band. The input format and an example of input data are given in Figs. 5 and 6, with Fig. 7 showing the resulting data-file page.

## 2 OUTPUT OPTIONS

The standard outputs are the Data-Log and Data-File listings, of which examples were shown in Figs. 4 and 7. A set of display options are also available to suit different users' needs.

### 2.1 Transmission Loss versus Range

When the transmission loss is required only for a few selected frequency bands, the  $TL=TL(R)$  is available, as shown in Fig. 8 for seven selected frequencies.

### 2.2 Transmission Loss versus Range and Frequency

When the transmission losses are required as function of both range and frequency a  $TL = TL(R, f)$  display is available, the losses being given as isoloss contours in the range/frequency plane. To eliminate small-scale fluctuations, different degrees of two-dimensional smoothing procedures can be applied to the data, as shown as in Fig. 9.

### 2.3 Transmission Loss versus Range and Depth

In the case of measurements when several hydrophone depths were used to sample the water column, a  $TL = TL(R, d)$  display is available, giving the losses as isoloss contours in the range/depth plane for selected frequency bands. An example for two frequencies is shown in Fig. 10.

### CONCLUSIONS

With the standardized filing format for shallow-water transmission-loss data it is possible:

1. To examine and extract acoustic characteristics of selected areas of strategic importance.
2. To compare and test theoretical predictions with real data to improve the acoustic prediction models being developed.
3. To conduct parametric studies so as to understand the dependence of complex shallow-water propagation on environmental parameters.
4. Express measured transmission loss values by simple semi-empirical expressions.
5. To provide standardized format for exchanging data between different ASW laboratories.

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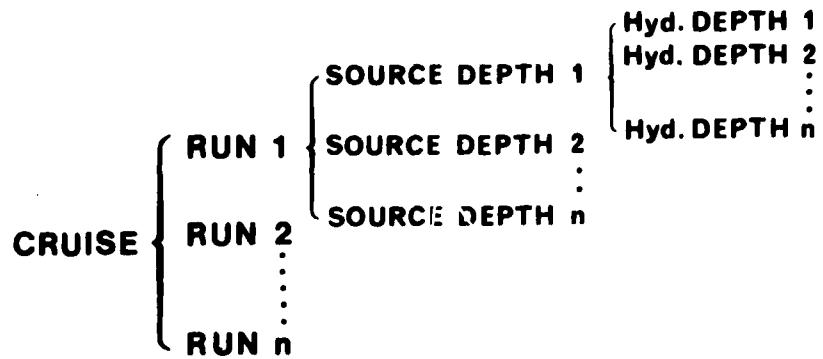


FIG. 1 ORGANIZATION OF DATA

1. Identification: Nation and laboratory which conducted the experiment. NAT (2), LAB (4).
2. Geographical position of the receiver:  
LAT (6), LONG (7)
3. Date: YEAR (2), MONTH (2), DAY (2), HOUR (4)
4. Acoustic run geometry:  
Direction (in degrees) and maximum distance (in km) of the run:  
DIRECTION (3), RANGE (3)  
Min and Max. water depth (in m) along the acoustic run track  
DEPTH (3), (3)  
Source and hydrophone depth (in m)  
SOURCE (4), HYD (4)
5. Frequency range of measurements (in Hz):  
FMIN (5), MAX (5)
6. Wind speed (in kn), sea state (2)\*, BT type (1)\* (see <8> )
7. Cruise, run and hydrophone identifiers  
CRUISE (12), RUN (12), HYD (12)
8. Data log number: consecutive number of each data unit (4)
9. Polynomial coefficients and standard deviation (in dB).  
A(6), B(6), C(6), D(6), SDV(3)
10. Comments (80)

Note: Numbers in brackets indicate maximum characters available

\* See Appendix A.

FIG. 2 DATA-LOG INPUT FORMAT

1. NT, SACL
2. 74.05N, 21.14E
3. 75, 07, 22, 1400
4. 055, 066, 000, 340, 0050, 0050
5. 00020, 08064
6. 10, 03, 2
7. BEAR, AREA A IV, M4, 50
8. 0016
9. 0.343, -1.534, 1.81, 53.9, 3.50
10. This is an example to fill an event for DATA-LOG

FIG. 3 EXAMPLE OF DATA-LOG INPUT

## DATA LOG

CRUISE+AREA BEAR A IV		QUALIFIER+FILENAME REAR+M4									
		WDEG (KMH)	(M)	(HZ)	(KTS)						
LAT	LONG	VR MO DY HOUR	DIR	RANGE	DEPTHs	FMIN+MAX	WNO	SS	BT	NAT	LAB
74.05N	21.14E	75 07 22 1400	55	66	340	20+8064	10	3	2	NT	SACL
DATA	DEPTHs(M)										
FILE	DEPTHs(M)										
NO	SOURCE+HYD	A	B	C	D	ST+DEV.	ELTNAME/VERSION				
0015	50+20						1/50				
0016	50+50	.343	-1.534	1.181	53.9	3.50	3/50				
0017	50+200						5/50				
0018	50+AVR	1.905	-1.606	0.357	52.5	2.60	MEDIA/50				
0019	200+20						1/200				
0020	200+50						3/200				
0021	200+200						5/200				
0022	200+AVR	1.594	-1.398	0.317	52.7	2.18	MEDIA/200				

FIG. 4 EXAMPLE OF DATA-LOG PAGE

1. Cruise, run, source, and hydrophone identifiers.  
CRUISE (12), RUN (12), SOURCE (12), HYD (12)
2. Number of ranges  
NR (3)
3. List of ranges (in m)  
 $R_1, R_2, \dots, R_n$  (6)
4. For each 1/3 octave band frequency measured transmission losses (in dB)

$F_1$  (5) -  $TL_1, TL_2, \dots, TL_n$  (3)

$F_2$  (5) -  $TL_1, TL_2, \dots, TL_n$  (3)

:

$F_n$  (5) -  $TL_1, TL_2, \dots, TL_n$  (3)

where  $F_i$  is the center frequency and  $TL_j$  is the transmission loss at range  $R_j$ .

Non-reliable TL values are entered as 327.

Note: Numbers in brackets indicate maximum characters available.

#### FIG. 5 DATA-FILE INPUT FORMAT

1. BEAR, AREA A IV, M4, 50, 50
2. 045
3. 150, 1341, 2814, ..... , 65370, 66861
4. 00020 - 044, 041, 047, ..... , 097, 094  
00025 - 047, 052, 050, ..... , 327, 327  
00031 - 044, 050, 050, ..... , 327, 102  
.....  
.....  
.....  
.....  
.....  
06400 - 048, 062, 069, ..... , 111, 118  
08064 - 080, 094, 102, ..... , 327, 327

#### FIG. 6 EXAMPLE OF DATA-FILE INPUT

CRUISE	PEAK	RUN NO.	HYD 3	S0 S0	CENTRE	FREQUENCY (HZ)	L0 S5 (DB)	20 31 50 79 126 200 317 504 800 1270+ 2026 3200 5080 8064																																					
150	40 47 44 47 53 50 66 47 49 47 56 53 50 51 48 52 52 49 50 48 49 48 48 47 46 49 48 40	41 50 50 54 62 57 56 59 58 60 60 59 62 60 61 62 61 62 64 63 64 66 63 64 65 67 66 66 69 102	47 52 50 55 59 58 60 60 56 61 64 65 63 63 61 62 62 63 65 68 66 69 69 71 73 73 74 107	50 55 57 53 60 60 56 61 64 65 63 63 61 62 62 63 65 68 66 69 69 71 73 73 74 113	55 58 56 58 64 62 61 61 60 61 63 63 66 66 63 60 68 67 68 70 71 70 71 72 75 75 75 113	63 71 60 60 67 66 62 67 65 61 64 64 65 63 64 65 67 68 67 69 72 75 78 75 76 80 114	65 65 65 64 63 65 62 63 65 67 62 68 68 68 69 69 72 73 75 73 75 78 80 83 84 86 121	75 70 64 66 67 66 69 64 66 67 68 68 66 68 68 68 73 72 74 76 76 76 81 83 85 86 88 121	77 77 70 69 74 68 68 67 66 63 68 68 66 71 69 72 74 73 79 77 78 79 81 85 88 89 122	79 72 68 66 69 67 67 66 69 69 67 68 73 71 72 74 75 78 79 78 81 84 86 87 87 91 125	80 80 69 67 74 74 68 67 68 73 69 71 72 73 74 75 76 79 79 79 81 82 83 87 91 93 126	80 76 72 66 71 71 68 70 68 69 68 74 71 71 74 74 77 79 79 83 83 86 86 92 93 96 126	82 72 66 69 75 75 69 72 69 72 70 69 78 80 74 79 78 84 327 327 327 327 327 327 327 327	81 81 74 69 73 74 67 71 72 73 73 74 73 76 75 77 76 76 80 82 85 85 87 90 93 96 128	80 79 73 69 76 71 71 73 73 69 71 74 74 74 76 79 80 81 84 81 85 86 87 91 96 128	93 85 78 72 71 75 70 71 71 72 74 75 73 76 76 77 74 81 84 84 84 86 87 90 94 97 129	92 87 79 72 80 74 74 71 74 73 75 75 77 76 77 80 80 83 85 85 86 87 88 91 93 96 100 130	87 84 78 72 73 78 69 76 75 75 75 76 76 78 77 81 83 83 85 85 86 86 88 91 93 96 100 132	89 86 84 75 79 74 73 74 76 71 73 76 76 76 78 79 82 82 83 84 86 87 89 92 95 98 102 133	92 91 81 74 77 74 71 73 78 73 75 78 80 77 78 79 81 82 85 87 89 89 90 95 97 102 133	89 89 84 80 77 78 72 72 75 74 75 80 80 76 81 80 83 83 87 88 89 90 92 95 100 103 133	91 90 82 83 78 79 75 75 78 74 76 75 80 78 83 82 83 86 87 89 91 93 93 98 103 105 135	93 92 86 81 83 80 75 77 79 76 74 76 80 79 82 84 85 86 87 90 90 93 95 99 104 106 135	301 97 88 89 83 82 77 77 80 84 76 80 78 81 82 82 85 85 88 90 92 93 94 98 103 108 107 137	96 95 87 85 85 80 78 77 78 78 77 76 80 78 82 84 86 88 91 93 95 99 103 109 107 138	302 94 88 87 85 82 79 77 79 79 78 77 77 82 84 83 86 90 92 93 94 96 99 102 108 107 138	302 101 91 87 85 82 77 78 78 79 81 78 81 82 85 83 87 89 92 93 94 96 98 99 106 110 109 138	80593 101 91 86 86 82 81 79 81 78 79 81 82 82 85 87 88 89 94 96 98 99 102 109 111 110 140	42087 106 100 91 92 88 83 80 81 80 83 79 82 82 85 85 85 86 88 89 90 93 95 98 98 103 107 112 109 148	43674 104 102 97 92 91 86 84 84 84 82 84 85 84 86 84 86 89 91 94 97 98 99 103 106 112 116 114 146	45279 307 100 96 91 90 88 81 83 83 79 78 80 81 85 87 87 89 93 93 97 98 101 104 109 114 112 142	46854 95 98 96 90 94 87 82 81 81 79 82 82 82 86 86 89 90 94 96 98 101 103 106 111 116 116 143	48456 104 105 98 91 91 88 83 85 83 84 81 80 83 84 88 89 90 94 98 100 101 104 107 110 113 114 141	50003 99 103 100 95 92 90 84 85 86 84 79 85 87 88 88 91 93 95 97 101 104 107 110 114 120 110 146	51615 106 114 101 93 102 96 86 87 85 84 86 84 90 97 89 91 95 95 99 102 106 111 113 117 114 112 127	53193 114 108 103 97 99 98 88 88 87 87 88 86 87 88 89 93 95 95 98 108 106 111 120 117 119 127 110 127	54711 304 327 105 99 95 97 90 90 87 88 87 86 91 89 89 95 98 99 103 106 110 105 121 131 127 115 127	56268 327 327 104 102 99 96 90 90 86 88 88 89 90 90 93 97 98 106 106 109 327 119 120 327 112 327	57822 101 104 327 109 99 93 88 88 89 87 85 83 86 89 90 91 95 97 106 105 108 116 327 327 123 327 157	59373 96 117 103 99 96 97 92 88 89 88 88 88 88 89 92 91 97 99 102 106 110 113 118 116 327 327 115 327	60882 118 327 327 104 98 99 91 88 87 92 85 89 89 91 93 94 96 100 104 109 111 116 115 327 327 123 327 157	62373 113 113 327 103 101 96 93 88 87 87 89 90 90 92 93 95 99 103 106 111 113 327 112 124 128 115 151	63801 107 327 107 327 95 327 327 87 87 90 87 87 90 93 95 98 103 106 112 114 115 117 327 327 117 327	65370 97 327 327 327 100 95 94 89 88 87 90 89 90 92 94 97 98 103 106 114 115 117 327 327 113 120 111 327	66461 94 327 102 99 327 98 91 89 90 96 89 90 89 90 92 95 97 100 109 105 107 327 113 327 108 118 327

FIG. 7 EXAMPLE OF DATA-FILE PAGE

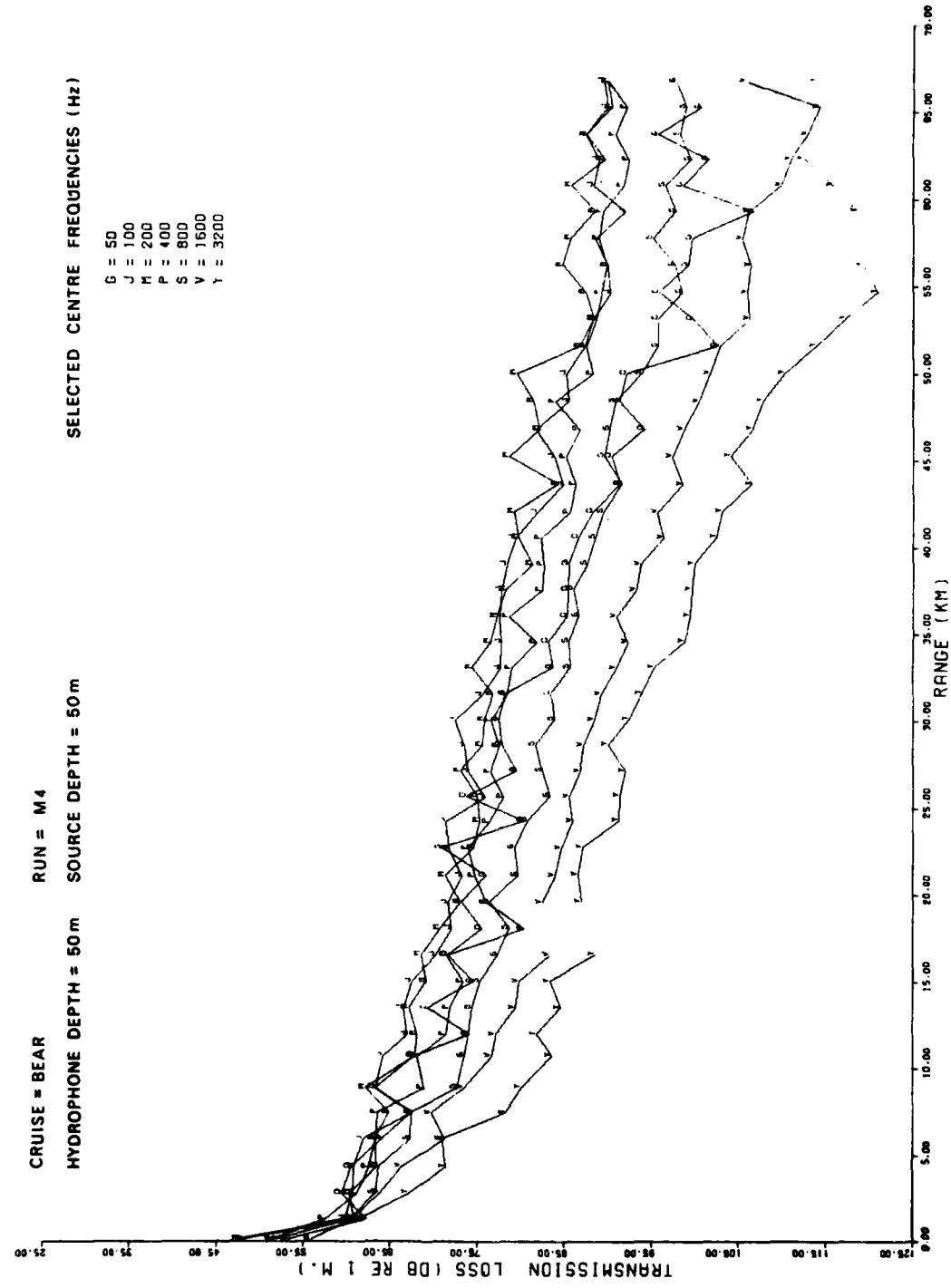


FIG. 8 TRANSMISSION LOSS VERSUS RANGE FOR SELECTED FREQUENCIES

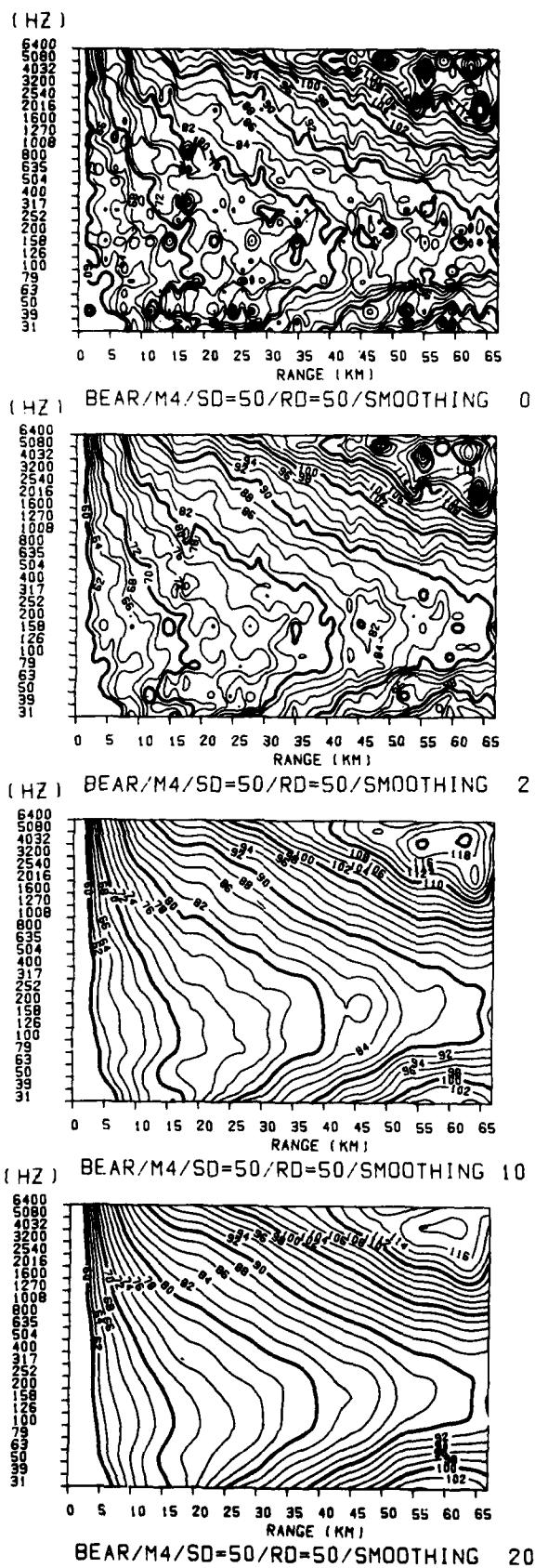


FIG. 9 TRANSMISSION LOSS CONTOURS AND THE EFFECT OF DIFFERENT DEGREES OF SMOOTHING

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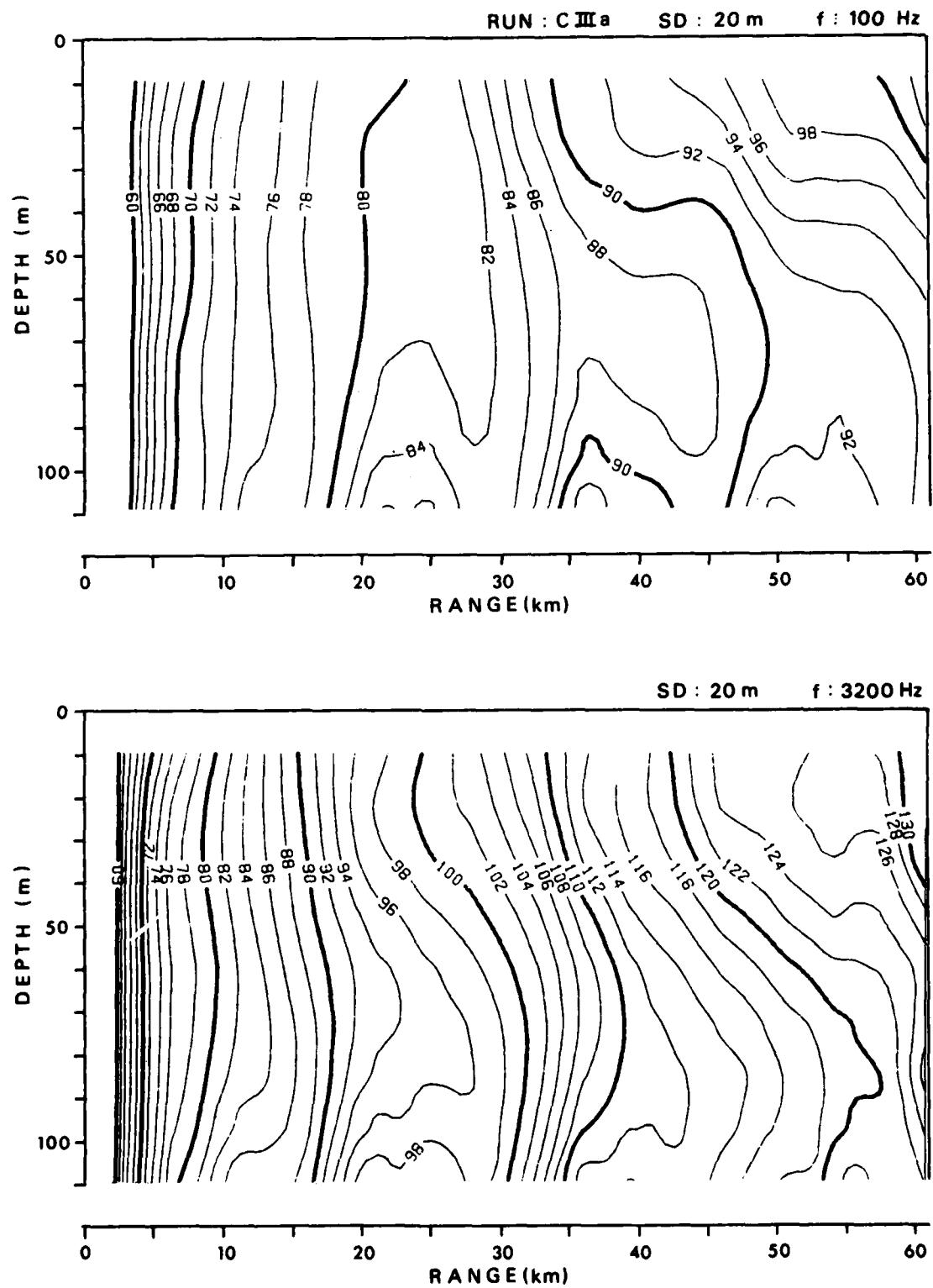


FIG. 10 TRANSMISSION LOSS CONTOURS IN RANGE AND DEPTH FOR SELECTED FREQUENCIES